Breastmilk Harbors Antibodies to SARS-CoV-2

An abundance of immunoglobulin antibodies, and a paucity of viral RNA, in breastmilk offer evidence that women can safely continue breastfeeding during the pandemic.

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Milk from lactating moms may hold potent antibodies to counter SARS-CoV-2 infections, according to a new study of 15 women. All of the samples from women who had recovered from COVID-19 and who were breastfeeding babies at the time had antibodies reactive to the virus's spike protein, researchers report in the November issue of *iScience*.

Detecting antibodies against the virus in breastmilk indicates that mothers could be passing viral immunity to their babies. Women can "feel pretty comfortable breastfeeding" during the pandemic, Christina Chambers, a perinatal epidemiologist at the University of California, San Diego, who not involved in the new study, tells *The Scientist.*

To date, there's no evidence that a mother can transmit SARS-CoV-2 to her baby through breastmilk, Chambers says. She and others have tested breastmilk for SARS-CoV-2 RNA and found a few positive results, but no live virus. Her latest research also suggests that donor milk is safe for babies' consumption, too, though she hasn't assessed antibodies in donor milk banks she works with yet.

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—Rebecca Powell, Icahn School of Medicine at Mount Sinai

Antibodies in breastmilk may be useful for more than protecting nursing infants from the virus. Antibodies extracted from milk—as opposed to the current practice of using convalescent serum—could also serve as a therapeutic for COVID-19. However, "people question that this is something that could really happen," says study coauthor Rebecca Powell, an immunologist at the Icahn School of Medicine at Mount Sinai in New York City. Because there isn't a wider understanding of the immune benefits of breastmilk, she says, the concept has not caught on in antiviral drug development.

Detecting breastmilk antibodies

Powell has been investigating human milk immunology for the past four years and was analyzing how the seasonal flu vaccine prompted an immune response in breastmilk when the coronavirus pandemic spread to New York City earlier this year. Switching to study the SARS-CoV-2 immune response in breastmilk was "a no brainer," she says. "There's so many unanswered questions in general about milk immunology, but to be able to study it with a novel pathogen was really important."

By early April, she and her colleagues had received approval to begin collecting milk samples from lactating mothers who had recovered from COVID-19. The researchers collected samples from eight women who had a SARS-CoV-2–positive PCR test and seven who had suspected cases of the disease but were not tested; all 15 were lactating at the time. The team then compared the samples to ones from different lactating mothers amassed before the pandemic began, first assessing them for the presence of immunoglobulin A (IgA) antibodies using an enzyme-linked immunosorbent assay (ELISA) and then checking the ability of any antibodies found to bind to the SARS-CoV-2 spike protein.

All the of samples from the women who had recovered from COVID-19 had specific SARS-CoV-2 binding activity, while the pre-pandemic samples had low levels of nonspecific or cross-reactive activity, the researchers report. They next tested the antibodies' response to the receptor binding domain of the SARS-CoV-2 spike protein, and found that 12 out of 15 of the samples from previously-infected donors showed significant IgA binding activity. Some of those samples also included other reactive antibodies such as immunoglobulin G and immunoglobulin M. Compared with the controls, it was IgA and IgG levels that were the highest.

The results align with a study published in September in the *Journal of Perinatology* that also detected high levels of IgA and some IgG and IgM that were reactive to the S1 and S2 subunits of the SARS-CoV-2 spike protein in a majority of milk samples collected during the pandemic. None of the breastmilk tested positive for SARS-CoV-2 with a PCR test, suggesting none of the mothers were infected at the time of sample collection.

There was also no documentation of whether the 41 women who donated samples had ever been infected with the virus, notes study coauthor Veronique Demers-Mathieu, an immunologist at

Medolac Laboratories in Boulder City, Nevada, so it's unclear if these antibodies were the result of SARS-CoV-2 or another viral infection.

The team did collect general health information on the donors of the milk samples and found that S1 and S2 SARS-CoV-2–reactive IgG levels were higher in milk from women who had had symptoms of a viral respiratory infection during the last year than in milk from women who hadn't had any symptoms of infection. IgG abundance was also higher in the samples from 2020 than from those taken in 2018, long before the pandemic started. The IgA and IgM antibody reactivity, however, didn't appear to be specific to SARS-CoV-2 S1 and S2 and did not differ between the 2020 samples and the 2018 samples, meaning these responses could be the result of cross-reactivity from antibodies generated after exposure to other viruses. That suggests the antibodies secreted in breastmilk provide a broad immunity to breastfeeding infants, Demers-Mathieu says.

Benefits of breastmilk versus blood antibodies

One important feature of these antibodies, whether specific to the virus or not, is that they are secretory antibodies, Powell notes. The B cells that secrete antibodies into milk originate from the mucosal immune system in the mother's small intestine. Those B cells travel through the blood to the mammary glands and secrete IgA that's then shuttled from the mammary tissue to the milk via a transporter protein. Those proteins, called secretory components, leave pieces of themselves on the antibodies, wrapping around them and protecting them from being degraded in the infant mouth and gut. "Secretory antibody is found not only in milk, but in saliva and all other mucosal secretions," Powell explains. "It's not unique to milk, but it is not what you find in the blood."

That difference could give breastmilk-derived antibodies an advantage over blood-based ones as far as therapeutic options go, she explains. Antibodies such as IgG that are extracted from serum and transfused into the blood of a sick person travel throughout the body and might not go where they are needed. But secretory antibodies, such as IgA from breastmilk, could be extracted and then inhaled into the respiratory tract—just where those antibodies are needed in COVID-19. Because of the protective secretory component they have, these antibodies can endure in the mucosa and target the virus, Powell explains.

"What we are finding in the milk is unique compared to what many people have already studied in the blood in terms of antibody response," she says. Research suggests that blood-derived antibodies can last months. Secretory antibodies in breastmilk might last longer, Powell's most recent data indicate, and that means there could be a longer window to collect antibodies from lactating donors after they've recovered from COVID-19.

Neither Demers-Mathieu's nor Powell's studies tested whether the breastmilk antibodies could neutralize SARS-CoV-2, which is a next step in both teams' research. Powell has early results suggesting the breastmilk antibodies do neutralize the virus, and a company called Lactiga has partnered with her to continue developing the idea of extracting antibodies from breastmilk to counter COVID-19.

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